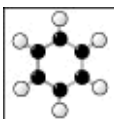


Working with Chemical Records

In this chapter, you'll find explanations of how to search for information about chemicals in the Chemical Library and how to predict the potential reactivity between chemicals, along with an explanation of the information about chemicals included in the Library.

The Chemical Library



The Chemical Library module contains more than 6,000 records. Each record describes a substance or mixture of substances, including its chemical name, trade names and other synonyms, identification numbers, regulatory information, and labeling conventions. For emergency responders and planners, the most important part of each chemical record is the **Response Information Data Sheet (RIDS)**, which contains a general description of the chemical, its physical properties, fire and health hazards, and recommendations for fire fighting and non-fire response, first aid, and protective clothing for response. RIDS information was compiled from a variety of source documents and databases (see “Sources of CAMEO’s chemical data” on page 100).


Searching for a Chemical Record

To view information about a chemical of concern, you first find the Chemical Library record describing that chemical. You can make either a **basic search** or a more **advanced search** for a record.

Making a basic search for a chemical record

Make a basic search when you just need to look up a chemical by its name, CHRIS code, UN number, CAS number, or other straightforward piece of identifying information. Here's how:



1. Begin the search in either of two ways:
 - a. While you're working in the Chemical Library, from the Search menu, select Start Search (as at left).
 - b. In the Navigator, click . (To access the Navigator, click the Navigator toolbar button or, from the File menu, select Show Navigator.)
2. In the Basic Search dialog, fill out the information you have about the chemical you're looking for. Check Table 1 on page 80 to see explanations of all the choices in the dialog.

If you fill in two or more criteria, CAMEO will search for chemicals that match all criteria. For example, if you type "slimicide" in the chemical name box and select "poison" from the DOT Label pull-down menu (as shown in Figure 1), the record for "ACROLEIN, INHIBITED" will be found. Although two other chemicals also share the synonym "slimicide," and almost 900 other CAMEO chemicals also are placarded as "poison" when they are transported, only acrolein meets both criteria.
3. If you've typed text into a box (e.g., if you type "slimicide" in the chemical name box), then click the button for either
 - Contains characters—to search for part of a word, phrase, code, or number.
 - Contains word starting with—to search either for the first part of or for an entire word, phrase, code, or number.

Note: For many searches, either choice will work, but sometimes the choice makes a big difference. For example, if you're searching for 1-

CAMEO Basic Search

Operator for text fields: ☐ Contains characters ☒ Contains word starting with

Chemical Name: slimicide

CAS #:

DOT Label:

CHRIS Code:

UN/NA Number:

Reactive Hazards:

General Description:

Note: If you enter multiple criteria, records containing all of your criteria will be found.

Go to Advanced Search Cancel Search

FIGURE 1. Searching for the poison, “slimicide.”

bromo 3-chloropropane, and you type “propane” in the Chemical Name box, you’ll find the chemical only if you select “Contains characters,” because this name contains the characters “propane,” but not at the beginning of a word.

4. Click Search to run your search.

CAMEO will run the search and then display either a list of the chemicals that match your criteria, or a message, “No records found,” if no chemicals in the Chemical Library match your criteria.

5. Double-click the name of any chemical in the Found Chemicals list to view that chemical’s record.

Whenever you want to return to the Found Chemicals list, press the “List” button in the toolbar. If you’d like to view the list of all CAMEO chemicals again, in the Search menu, select Clear Search.

TABLE 1. Criteria you can use in a basic search.

Name	Description
Operator for text fields	Choose “Contains characters” to search for part of a word, phrase, code, or number; or “Contains word starting with” to search either for the first part of or for an entire word, phrase, code, or number.
Chemical Name	Type all or part of the name, synonym, or trade name for the chemical.
CAS #	Type all or the first part of the Chemical Abstract Service number for the chemical, including all hyphens.
DOT Label	Select the required DOT label for the chemical from the pull-down menu (for example, “Flammable” or “Explosive”).
CHRIS Code	Type all or part of the U.S. Coast Guard’s three-letter code for a chemical (as used in the CHRIS guide to chemical hazards, www.chrismanual.com).
UN/NA Number	Type all or part of a chemical’s UN Number.
Reactive Hazards	Select a special reactive hazard of the chemical (e.g., “Water-Reactive” or “Strong Oxidizing Agent”) from the pull-down menu.
General Description	Type a word or phrase describing the appearance, behavior, or other attribute of the chemical, which you think might be included in its general description. For example, a search for “blue-green crystal” finds several chemicals with that appearance.

Making an advanced search for a chemical record

You can make an advanced search whenever you need to use other criteria than the ones available for a basic search. Here’s how:

1. Begin your search just as you would start a basic search: either
 - click Search for a Chemical in the Navigator, or
 - while you’re working in the Chemical Library, select Start Search from the Search menu.

2. Click Go to Advanced Search.
3. Click Select field to indicate which data field to search.
4. Click the radio button for either
 - Chemical ID and RIDS, to search for identifying information or response recommendations.
 - Properties, if you want to search for a physical property, such as boiling point or lower explosive limit.
5. In the list of searchable fields, click the name of a field, then click Select.
6. Choose an operator from the popup menu (e.g., “contains characters,” “is equal to,” or “is greater than”).

The operator to choose depends on the search you’re making.
7. Type the word, phrase, number, or code to search for in the box.

Leave the box empty if you don’t need to type something in—e.g., when you choose an operator like “is empty” or “is not empty.”
8. Click Search to run your search.

Some advanced search examples:

- EPCRA EHS Chemical (is) “YES” finds all Extremely Hazardous Substances in the Chemical Library.
- Boiling Point is less than or equal to 60 finds chemicals that are gases when unconfined at temperatures above 60°F.
- NFPA Flammability contains the character “4” finds all the substances that pose the maximum flammability hazard under the NFPA system.¹

Adding more choices. You can make an advanced search for records that match more than one criterion. To add a second criterion to your search,

1. While you’re working in the Advanced Search dialog, press Add a Choice to add a second criterion to search for.

1. Under the NFPA system, a chemical posing the highest possible flammability, reactivity, or health hazard is given a ranking of 4, on a 0 to 4 scale. (See “Under the NFPA Codes tab:” on page 87.)

- Follow steps 3 through 7 in “Making an advanced search for a chemical record” on page 80 to set up the search for that criterion.
- Indicate whether to search either for (a) records that meet *both* your criteria (click “Search for all of the following”) or (b) records that meet *either* criterion (click “Search for any of the following”).

Here’s an example of the difference between these two kinds of searches: To find out how many chemicals in the Chemical Library pose the most severe flammability, reactivity, *and* health hazard, you would click “Search for all of the following (AND search)” to search for values equal to “4” in the NFPA Flammability, NFPA Health Hazard, AND NFPA Reactivity boxes, as shown below.

The screenshot shows the "CAMEO Advanced Search" window. At the top, it says "Module to search: Chemical Library". Below this, there are two radio buttons: "Search for any of the following (OR search):" and "Search for all of the following (AND search):". The "AND search" option is selected. There are three search criteria listed, each with a "Select field:" dropdown, a "Search for this:" input field, and a "is equal to" operator. The first criterion is "NFPA Flammability" with the value "4". The second criterion is "NFPA Health Hazard" with the value "4". The third criterion is "NFPA Reactivity" with the value "4". At the bottom, there are buttons for "Clear All Fields", "Add a Choice", "Remove a Choice", "Cancel", "Search", and "Return to Basic Search".

You would find just four records that meet your criteria.

If, instead, you wanted to search for the chemicals that pose the most severe of *any one* of those hazards, you would click “Search for any of the follow-

ing (OR search)” to search for values equal to “4” in the NFPA Flammability, NFPA Health Hazard, OR NFPA Reactivity boxes, as shown below.

CAMEO Advanced Search

Module to search: Chemical Library Save This Search

☒ Search for any of the following (OR search): Open Saved Search

☐ Search for all of the following (AND search):

Select field: NFPA Flammability is equal to 4

OR

Select field: NFPA Health Hazard is equal to 4

OR

Select field: NFPA Reactivity is equal to 4

Clear All Fields Add a Choice Remove a Choice Cancel Search

Return to Basic Search

You would find about 200 records meeting these criteria.

To add another choice, click Add a Choice again. You can add up to four choices. If you need to search for more than four criteria, first run a search for the first four of your criteria, then choose Append Search (to widen your search) or Subset Search (to narrow your search) from the Search menu to add additional criteria (see “Append searches and subset searches” on page 254).

You can save any complex advanced search to reuse later. See “Saving searches” on page 253 for instructions.

Understanding the information in the Chemical Library

A chemical record contains two basic kinds of information, each represented by a main tab within the record: **Chemical Identification Information** (Figure 2) and a **Response Information Data Sheets** tab (Figure 3 on page 85).

The screenshot displays a web-based interface for a Chemical Library. At the top, a yellow header bar contains the text "Chemical Library". Below this, a yellow box labeled "Chemical Name" contains the text "HEXACHLOROACETONE". The main content area is divided into two sections: "Chemical Identification Information" (green background) and "Response Information Data Sheets" (purple background). The "Chemical Identification Information" section is further divided into five tabs: "Chemical Identification", "Synonyms", "NFPA Codes", "Regulatory Information", and "Screening and Scenarios". The "Chemical Identification" tab is active, showing fields for Formula, DOT Label, CAS #, UN/NA Number, STCC #, and CHRIS Code. The Formula field contains "C3Cl6O", the DOT Label field contains "POISON", the CAS # field contains "116-16-5", the UN/NA Number field contains "2661", the STCC # field contains "4925108", and the CHRIS Code field is empty. Each of these fields has a small icon to its right, likely for expanding or collapsing the field.

Chemical Identification Information		Response Information Data Sheets	
Chemical Identification		Synonyms	
NFPA Codes		Regulatory Information	
Screening and Scenarios			
Formula:	C3Cl6O	UN/NA Number:	2661
DOT Label:	POISON	CHRIS Code:	
CAS #:	116-16-5		
STCC #:	4925108		

FIGURE 2. View of the Chemical Information section of the record for Hexachloroacetone.

Check the Chemical Identification information to make sure that you're working with the record for the correct chemical, and to quickly see what legislation regulates uses of this chemical. Table 2 on page 86 includes explanations of each kind of chemical identification information in Chemical Library records.

Chemical Library				
Chemical Name HEXACHLOROACETONE				
Chemical Identification Information		Response Information Data Sheets		
Firefighting	Fire Hazards	Non-Fire Response	Health Hazards	Protective Clothing
General Description	Properties	Reactivity	Reactive Hazards	First Aid
<p>A yellow-colored liquid. Slightly soluble in water and denser than water. Vapors are much heavier than air. Irritates skin and eyes. May be toxic by ingestion or inhalation. Used to make other chemicals (© AAR, 1999).</p>				

FIGURE 3. View of the Response Information Data Sheet for Hexachloroacetone.

TABLE 2. Chemical identification information in a Chemical Library record.

Item	Description
Chemical Name	Name of the substance. Most often, this is the name used for this substance in the DOT Emergency Response Guidebook (USDOT 2000; see “Bibliography” on page 276). Otherwise, it’s usually the name for this substance listed in the Title III List of Lists (USEPA 2001; see “Bibliography” on page 276), or the name assigned by the U.S. Department of Transportation (as listed in 49 CFR 172—Subpart B—Table of Hazardous Materials and Special Provisions). In a few other cases, names were taken from other sources (see “Sources of CAMEO’s chemical data” on page 100).
Under the Chemical Information tab:	
Formula	Chemical formula used by the American Chemical Society.
DOT Label	Required DOT label for the chemical. This label must be displayed on shipped packages, railroad tank cars, and tank trucks according to specifications described in 49 CFR § 172.
CAS#	Chemical Abstract Service registry number. Identification number assigned to this chemical by the American Chemical Society.
UN/NA Number	The United Nations-North America number. This numbering system was developed by the U.S. Department of Transportation, and then became the UN standard system for classifying hazardous materials.
STCC#	Standard Transportation Commodity Code. Seven-digit chemical identification code used by the Association of American Railroads.
CHRIS Code	Three-letter code used by the U.S. Coast Guard to identify individual chemicals included in its CHRIS guide to chemical hazards (www.chrismanual.com).
Under the Synonyms tab:	
Synonyms	Names for this chemical, including trade names and other synonyms.

TABLE 2. Chemical identification information in a Chemical Library record. (Continued)

Under the NFPA Codes tab:	
NFPA codes represent hazards posed by a chemical. A ranking of “0” in one of the fields listed below represents little hazard to health, low flammability, or little reactivity. Higher rankings represent increased hazard. A “4” represents the highest hazard in all three categories.	
Flammability	NFPA code 0 - 4, representing flammability hazard of the chemical.
Health	NFPA code 0 - 4, representing health hazard of the chemical.
Reactivity	NFPA code 0 - 4, representing the chemical’s reactivity.
Special	Notations that alert you to especially significant hazards posed by a few chemicals: “No water” means that the chemical is unusually reactive with water and “Oxidizer” means that the material is a strong oxidizer.
Under the Regulatory Information tab:	
Names	Names under which this substance is regulated under Federal laws such as CERCLA, EPCRA, RCRA, and the Clean Air Act of 1990.
CAA Section 112(r) chemical	Checkbox. If checked, this chemical has been listed as a toxic, flammable, or explosive hazardous substance under Section 112(r) of the Clean Air Act.
CERCLA Chemical	Checkbox. If checked, this chemical is listed as a hazardous substance under CERCLA (40 CFR § 302).
EPCRA EHS Chemical	Checkbox. If checked, this is an Extremely Hazardous Substance (EHS), identified by the U.S. Environmental Protection Agency as an acute inhalation toxic threat, and listed under EPCRA.
ECPRA Section 313 chemical	Checkbox. If checked, this chemical has been included in a list of toxic chemicals covered under Section 313 of EPCRA. Facilities storing or using Section 313 chemicals may be required to submit annual reports of the amount of each chemical released into the environment, either routinely or by accident (see 40 CFR § 372).
CAA Threshold Quantity	Threshold Quantity listed in the Clean Air Act. When stored quantities of this substance exceed this amount, a facility becomes subject to the accidental release prevention provisions of the Act.

TABLE 2. Chemical identification information in a Chemical Library record. (Continued)

CERCLA Reportable Quantity	Reportable Quantity (RQ) listed in CERCLA. Threshold release size established by the U.S. Environmental Protection Agency. A facility must report spilled quantities in excess of the RQ to Federal, state, and local governments.
EHS Threshold Planning Quantity	Extremely Hazardous Substance Threshold Planning Quantity, listed in 40 CFR § 355. When storage quantities of a hazardous chemical at a facility exceed this threshold, the reporting, community right-to-know, and emergency planning requirements of EPCRA must be met.
RCRA Chemical Code	Four-character identification code assigned to this substance under the Resource Conservation and Recovery Act of 1976 (RCRA).
Under the Screening and Scenarios tab:	
Liquid Factor (Ambient)	A factor required to calculate evaporation rate of a liquid at ambient temperature, using methods described in <i>Technical Guidance for Hazards Analysis</i> (USEPA, FEMA, and USDOT 1987; see “Bibliography” on page 276).
Liquid Factor (Boiling)	A factor required to calculate evaporation rate of a liquid at or above its boiling point, using methods in the <i>Technical Guidance</i> .
Liquid Factor (Molten)	A factor required to calculate rate of release of a molten solid, using methods in the <i>Technical Guidance</i> .
Level of Concern	LOC. The concentration of the chemical, in grams per cubic meter, above which there may be serious, irreversible health effects as a result of a single exposure for a relatively short period of time. Defined in the <i>Technical Guidance</i> . Local authorities may establish additional LOCs for their hazards analyses.
Ambient State	The physical state (solid, liquid, or gas) of the chemical at 68°F.

Refer to a chemical’s RIDS information when you need to see recommendations for response to releases of that chemical. Table 3 includes explanations of each of the kinds of information under the Response Information Data Sheets tab in each chemical record. Table 4 on page 90 shows the full

names of protective materials listed under the Protective Clothing tab; these names are shown abbreviated in CAMEO.

TABLE 3. Response Information Data Sheet information in a Chemical Library record.

Tab Title	Tab Contents
General Description	General appearance, behavior, and toxicity of the chemical.
Properties	Physical properties, flammability limits, and toxic thresholds (toxic exposure limits). Check “Glossary” on page 279 to view a definition of each physical property.
Reactivity	Description of the potential reactivity between the chemical and other chemicals, as well as its reactivity with air and water, and any other intrinsic reactive hazards (e.g., polymerizability, peroxidizability). Also includes a list of the reactive groups to which this chemical belongs.
Reactive Hazards	Special reactivity alerts for the chemical.
First Aid	Response recommendations.
Firefighting	Response recommendations for fire incidents in which the chemical is involved.
Fire Hazards	Description of the chemical’s flammability, byproducts that may evolve if the chemical is burned, and risk of explosion.
Non-Fire Response	Response recommendations for incidents not involving fire, in which the chemical is involved.
Health Hazards	Description of the health hazards of the chemical, such as toxicity, flammability, and corrosivity.
Protective Clothing	Recommendations and table of breakthrough times for protective materials. See Table 4 for the full names of listed materials (which are shown abbreviated on Chemical Library records).

TABLE 4. Full names of protective materials listed under the Protective Clothing tab on Chemical Library records.^a

Abbreviation displayed in CAMEO	Full name of the protective material
ACRYLIC	Same
AL PE	Aluminized Polyethylene
AL PE/PET	Aluminized Polyethylene/Polyethylene Terephthalate
AL PET	Aluminized Polyethylene Terephthalate
AL PET/PVC	Aluminized Polyethylene Terephthalate/Polyvinyl Chloride
AL PVF	Aluminized Polyvinyl Fluoride
BARRICADE	Plastic Laminate (Dupont Company)
BLUE MAX	Plastic Laminate (MSA Company)
BUTYL	Butyl Rubber
BUTYL/NAT RUB	Butyl Rubber/Natural Rubber
BUTYL/NEOP	Butyl Rubber/Chloroprene Rubber
CELLULOSE ACETATE	Same
CELLULOSE PROPIONATE	Same
CHECKMATE	Plastic Laminate (Lakeland Company)
CHEMREL	Plastic Laminate (Chemron Company)
CHEMREL MAX	Plastic Laminate (Chemron Company)
CHEMTUFF	Plastic Laminate (Chemron Company)
CHLOROBUTYL	Chlorobutyl Rubber
COMFORT-GARD II	Comfort-Gard II Fabric
CPE	Chlorinated Polyethylene
CPE/SARAN	Chlorinated Polyethylene/Polyvinylidene Chloride
CPE+HYPALON+PVC	Chlorinated Polyethylene + Hypalon + Polyvinyl Chloride

TABLE 4. Full names of protective materials listed under the Protective Clothing tab on Chemical Library records.^a (Continued)

Abbreviation displayed in CAMEO	Full name of the protective material
CPF III	Plastic Laminate (Kappler Company)
CR 39	CR 39
ECO/BUTYL	Epichlorohydrin/butyl Rubber
EMA	Ethylene - Methyl Acrylate
EPDM/BUTYL	Ethylenepropylene/butyl Rubber
EPDM+NAT RUB	Ethylenepropylene + Natural Rubber
EVAC	Ethylene Vinyl Acetate
FEP TEFLON	Fluorinated Ethylene Propylene
FEP/PTFE	Fluorinated Ethylene Propylene/Polytetrafluoroethylene
GORE-GARD	Gore-Gard Fabric
GORE-TEX	Gore-Tex Fabric
HYPALON	Same
HYPALON/NEOP	Hypalon/Chloroprene Rubber
INTERCEPTOR	Plastic Laminate (Lakeland Company)
MET PVF	Metallized Polyvinylfluoride
NAT RUB	Natural Rubber
NAT RUB+BAYPRENE	Natural Rubber + Bayprene
NAT RUB+NEOP	Natural Rubber + Chloroprene Rubber
NAT RUB+NEOP+NBR	Natural Rubber + Chloroprene Rubber + Nitrile-Butadiene Rubber
NAT RUB+NITRILE	Natural Rubber + Nitrile Rubber
NAT RUB+NITRILE+SBR	Natural Rubber + Nitrile Rubber + Styrenebutadiene Rubber
NEOP	Chloroprene Rubber

TABLE 4. Full names of protective materials listed under the Protective Clothing tab on Chemical Library records.^a (Continued)

Abbreviation displayed in CAMEO	Full name of the protective material
NEOP/BUTYL	Chloroprene Rubber/Butyl Rubber
NEOP/NAT RUB	Chloroprene Rubber/Natural Rubber
NEOP+NAT RUB/NITRILE	Chloroprene Rubber + Natural Rubber/nitrile Rubber
NEOP+PVC	Chloroprene Rubber + Polyvinyl Chloride
NEOP+PVC	Chloroprene Rubber + Polyvinyl Chloride
NEOP+SBR	Chloroprene Rubber + Styrenebutadiene Rubber
NITRILE	Nitrile Rubber
NITRILE/NAT RUB	Nitrile Rubber/Natural Rubber
NITRILE+PVC	Nitrile Rubber + Polyvinyl Chloride
NONWOVEN FABRIC	Same
PCTFE	Polychlorinated trifluoroethylene
PE	Polyethylene
PE/EVAL/PE	Polyethylene/Ethylene Vinyl Alcohol/Polyethylene
PET	Polyethylene Terephthalate
PETG	Polyethylene Terephthalate, Modified
POLYCARBONATE	Same
POLYIMIDE	Same
POLYISOPRENE	Same
POLYSULFONE	Same
POLYURETHANE	Polyurethane Rubber
POLYURETHANE/NAT RUB	Polyurethane Rubber/Natural Rubber
POLYURETHANE/NIT+PVC	Polyurethane Rubber/Nitrile Rubber + Polyvinyl Chloride

TABLE 4. Full names of protective materials listed under the Protective Clothing tab on Chemical Library records.^a (Continued)

Abbreviation displayed in CAMEO	Full name of the protective material
POLYURETHANE+PVC	Polyurethane Rubber + Polyvinyl Chloride
POLYVINYL CHLORIDE	Same
PP	Polypropylene
PTFE TEFLON	Polytetrafluoroethylene Teflon
PVAC	Polyvinyl Acetate
PVAL	Polyvinyl Alcohol
PVAL/PE	Polyvinyl Alcohol/Polyethylene
PVC	Polyvinyl Chloride
PVDC	Polyvinylidene Chloride
RESPONDER	Plastic Laminate (Life-Guard Company)
SARANEX23P	Polyethylene/Polyvinylidene Chloride/Polyethylene/Tyvek
SBR	Styrenebutadiene Rubber
SBR/NEOP	Styrenebutadiene Rubber/Chloroprene Rubber
SILICONE RUB	Silicone Rubber
SILVER SHIELD	Same
TRELLCHEM HPS	Plastic Laminate (Trellchem Company)
TYVEK QC SUPRA	Polyethylene/Tyvek
VELOSTAT	Microporous Polyolefin
VITON	Fluoroelastomer
VITON/BUTYL	Fluoroelastomer/Butyl Rubber
VITON/BUTYL/NEOP	Fluoroelastomer/Butyl Rubber/Chloroprene Rubber
VITON/CHLOROBUTYL	Fluoroelastomer/Chlorobutyl Rubber

TABLE 4. Full names of protective materials listed under the Protective Clothing tab on Chemical Library records.^a (Continued)

Abbreviation displayed in CAMEO	Full name of the protective material
VITON/NEOP	Fluoroelastomer/Chloroprene Rubber
VITON/NITRILE	Fluoroelastomer/Nitrile Rubber

a. In abbreviations, “+” indicates a blend of two or more materials; “/” indicates that two or more materials are layered.

Predicting potential chemical reactivity

Reactivity is the tendency of substances to undergo chemical change. You can use CAMEO to find out about the reactivity of substances or predict the reactivity of mixtures of substances. You can

- Check any chemical’s intrinsic reactive properties, such as peroxidizability, polymerizability, and radioactivity.
- “Virtually mix” chemicals to find out what dangers could arise if they were accidentally mixed together. To make reactivity predictions, you select chemicals from the Chemical Library module, and add them to a “mixture.” CAMEO then predicts the reactivity of this mixture

How CAMEO predicts mixture reactivity

Each substance in the Chemical Library was assigned to one or more reactive groups, based on the known chemistry of that substance.² Reactive groups are categories of chemicals that react in similar ways because they are similar in their chemical structure.³

2. CAMEO’s reactivity prediction method was inspired by earlier work by the Hazardous Materials Management Section of the California Department of Health Services, and by the U.S. Coast Guard. To develop CAMEO’s method, the CAMEO team was substantially aided by Dr. Wade Freeman and Dr. Mike Krumpolc of the University of Illinois.

Predicting potential chemical reactivity

To find out which reactive groups a particular chemical belongs to, find that chemical's record in the Chemical Library, click the Response Information Data Sheets tab, and then click the Reactivity tab. Under the REACTIVE GROUPS heading, you'll see the reactive group(s) to which the chemical belongs (as shown in Figure 4).

Chemical Library

Chemical Name
ACROLEIN, INHIBITED

Chemical Identification Information		Response Information Data Sheets		
Firefighting	Fire Hazards	Non-Fire Response	Health Hazards	Protective Clothing
General Description	Properties	Reactivity	Reactive Hazards	First Aid

REACTIVE GROUPS:
ACROLEIN, [INHIBITED] can react violently with oxidizing agents. Polymerizes exothermically on contact with small amounts of acids (including sulfur dioxide), alkalis, volatile amines and pyridines, salts, thiourea, oxidizing agents (air) and on exposure to light and heat. Polymerization initiated by amines and pyridines occurs after a deceptive induction period. Water solutions of mineral acids and metal ions can initiate polymerization. The inhibitor (usually hydroquinone) greatly reduces tendency to polymerize. Undergoes Diels-Alder reaction with itself to give acrolein dimer. This can become a runaway reaction at 90°C [Kirk-Othmer, 4th Ed, Vol. 1]. Mixing in equal molar portions with any of the following substances in a closed container caused the temperature and pressure to increase: 2-aminoethanol, ammonium hydroxide, chlorosulfonic acid, ethylenediamine, ethyleneimine [NFPA 1991].

REACTIVE GROUPS:
Aldehydes (Reactivity, 2001)

FIGURE 4. Acrolein belongs to the “Aldehydes” reactive group.

- Each substance in the Chemical Library has been assigned to one or more of the following reactive groups (these are structurally distinctive chemical groups, within which the members behave similarly): acid halides; acids, inorganic nonoxidizing; acids, inorganic oxidizing; alcohols; aldehydes; amides; amines; anhydrides; azo, diazo, azido; bases, cfc's, hcfc's; carbamates; chlorosilanes; cyanides, inorganic; epoxides; esters; ethers; halogenated organics; halogenating agents, strong; hydrocarbons, aliphatic saturated and unsaturated; hydrocarbons aromatic; inorganic compounds/neither oxidizing or reducing; inorganic oxidizing agents; inorganic reducing agents; isocyanates; ketones; metal hydrides; metals, alkali; metals, elemental; metals, less reactive; nitrides; phosphides; carbides; silicides; nitriles; nitrites; nitrates; organometallics; peroxides; phenols; phosphates, thiophosphates; acidic salts; basic salts; inorganic sulfides; organic sulfides, thiocarbamate salts, dithiocarbamate salts.

To see detailed descriptions of all the reactive groups used in CAMEO, check CAMEO's online help.

To predict the reactivity of a mixture of chemicals, CAMEO first identifies the reactive groups to which each of the chemicals belongs, and then predicts the kinds of chemical reactions likely to occur when members of these groups are mixed together.

Reactivity predictions are pairwise. CAMEO only predicts the reactivity between two chemicals at a time. If you virtually “mix” three or more chemicals, it will predict the reactivity between each of the possible pairings of those chemicals.

Be aware that:

- sometimes, three or more chemicals can react in ways CAMEO can't predict. For example, sulfuric acid, nitric acid, and glycerine react to produce nitroglycerine. CAMEO recognizes that this mixture would be very reactive, but does not predict that nitroglycerine would be produced.
- sometimes, one chemical can catalyze (speed up) the reaction between other chemicals. For example, nickel carbonyl catalyzes many polymerization reactions and other kinds of synthetic organic reactions. CAMEO cannot predict when a reaction between two chemicals could be speeded up by another chemical.

However, reactions among more than two chemicals are relatively uncommon in nature (except for the catalyzed reactions that are common components of the metabolic processes of living organisms).

Making a reactivity prediction

Here are the steps for predicting the potential chemical reactions between two or more chemicals:

1. Find and open the Chemical Library record for one of the chemicals (see “Searching for a Chemical Record” on page 78).
2. From the Record menu, select Add to Reactivity Worksheet.

Predicting potential chemical reactivity

3. When asked whether you'd like to view the Worksheet, click Later.
4. Find and open the record for one of the other chemicals.
5. From the Record menu, select Add to Reactivity Worksheet.
6. When asked whether you'd like to view the Worksheet, click either
 - Later, if you have more chemicals to add. In this case, repeat steps 1 and 2 until you've added all the chemicals, then click Yes.
 - Yes, if you have finished adding chemicals.

The Reactivity Worksheet will be displayed. In the Worksheet, you'll see a list of the chemicals you've "mixed," followed by a listing of the potential hazards from reactivity between those chemicals (as shown in Figure 5). If you have mixed more than two chemicals, you'll see a summary of the hazards of all possible pairings of the chemicals, followed by a list of the hazards from each possible pairing.

Reactivity Worksheet

Chemicals In the Mixture

CALCIUM CARBIDE
VINYL CHLORIDE

(Double click chemical to see chemical specific reactivity information)

Hazards from mixing the reactive groups for the chemicals listed above

VINYL CHLORIDE mixed with CALCIUM CARBIDE - Flammable gas generation - Heat generation by chemical reaction, may cause pressurization - Can become highly flammable in use; causes pressurization

FIGURE 5. The Reactivity Worksheet.

7. Click Make Report if you'd like to print your results. Once you've completed your work, you can click Remove All to clear all the chemicals

from the Reactivity Worksheet (the Worksheet will be cleared when you quit from CAMEO).

Note: In CAMEO, you can “mix” only individual chemicals. Using the Chemical Reactivity Worksheet program, you also can mix reactive groups along with chemicals. You might want to do this if you know the chemical class of a substance, but not its exact name or CAS number, or if you know a substance’s chemical class (e.g., its MSDS may state its class), and the substance is not in the Chemical Library. You also can use the Chemical Reactivity Worksheet program to create compatibility charts for use in laboratories or other locations where many chemicals are stored close together (CAMEO cannot produce compatibility charts). You can obtain the Worksheet program or learn more about it at response.restoration.noaa.gov/chemaids/react.html.

Significant reactive hazards of some chemicals

Substances that pose certain special or acute reactivity-related hazards are categorized not only into reactivity groups, but also into nine **Reactive Hazard** classes shown in Table 5. To check whether a chemical poses any of these acute reactive hazards,

1. Find that chemical’s record in the Chemical Library,
2. Click the Response Information Data Sheets tab, then click the Reactive Hazards tab to see the acute reactive hazards of that chemical (as in Figure 6).

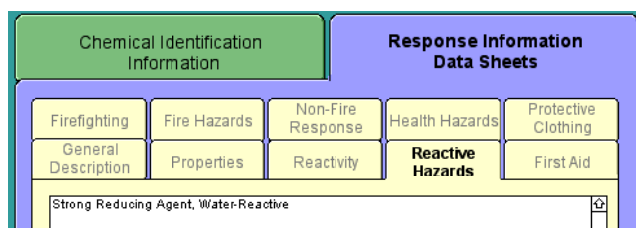


FIGURE 6. The acute reactive hazards of calcium carbide.

Predicting potential chemical reactivity

You also can search the Chemical Library to find all the chemicals that pose a particular reactive hazard. For example, to find all the water-reactive chemicals in the Library,

1. From the Search menu, select Start Search.
2. From the Reactive Hazards pull-down menu, select “Water-Reactive.” Click Search. You’ll see a list of the more than 500 water-reactive chemicals in the Chemical Library.

TABLE 5. CAMEO’s Reactive Hazard classes.

Reactive Hazard class	Definition
Highly flammable	Substances having a flash point of less than 100°F and mixtures that include substances with flash points of less than 100°F.
Explosive	A material synthesized or mixed deliberately to allow the very rapid release of chemical energy. Also, a chemical substance that is intrinsically unstable and liable to detonate under conditions that might reasonably be encountered.
Polymerizable	Capable of undergoing self-reactions that release energy. Some polymerization reactions generate a great deal of heat. The products of polymerization reactions are generally less reactive than the starting materials.
Strong oxidizing agent	Oxidizing agents gain electrons from other substances and are themselves thereby chemically reduced. Strong oxidizing agents accept electrons particularly well from a large range of other substances. The ensuing oxidation-reduction reactions may be vigorous or violent and may release new substances that may take part in further additional reactions. Strong oxidizing agents should be kept well separated from strong reducing agents. In some cases, the presence of a strong oxidizing agent can greatly enhance the progress of a fire.
Strong reducing agent	Reducing agents give up electrons to other substances. They are themselves thereby oxidized. Strong reducing agents donate electrons particularly well to a large range of other substances. The ensuing oxidation-reduction reactions may be vigorous or violent and may generate new substances that take part in further additional reactions.

TABLE 5. CAMEO's Reactive Hazard classes. (Continued)

Reactive Hazard class	Definition
Water-reactive	Substances that may react rapidly or violently with liquid water and steam, producing heat (or fire) and often toxic reaction products.
Air-reactive	Likely to react rapidly or violently with dry air or moist air. May generate toxic and corrosive fumes upon exposure to air, or may catch fire.
Peroxidizable Compound	Apt to undergo spontaneous reaction with oxygen (a component of air) at room temperature, to form peroxides and other products. Most such autooxidations are accelerated by light or by trace impurities. Many peroxides are explosive, which makes peroxidizable compounds a particular hazard. Ethers and aldehydes are particularly subject to peroxide formation (the peroxides generally form slowly after evaporation of the solvent in which a peroxidizable material had been stored).
Radioactive Material	Spontaneously and continuously emitting ions or ionizing radiation. Radioactivity is not a chemical property, but an additional hazard that exists in addition to the chemical properties of a material.

Sources of CAMEO's chemical data

Information displayed in the Chemical Library was compiled from a variety of documents and databases, each prepared by a different organization, such as the American Association of Railroads or the EPA. Information sources are identified in two ways:

- Following each piece of information displayed in a Response Information Data Sheets field is the abbreviation for the source from which that information was taken and that source's date of release, shown in parentheses: for example, "(USCG, 1999)."⁴

4. The sole exception to this rule is Reactive Hazards; this information was generated by NOAA during the development of the Chemical Reactivity Worksheet.

- Table 6 on page 102 shows the sources of the chemical identification information included in each record in the Chemical Library, and Table 7 on page 103 shows the sources of the RIDS information for each chemical.

For a description of each source document or database, see “Bibliography” on page 276. In the Bibliography, a notation in brackets (such as “[EPA]”) appearing within a citation indicates that the cited reference is one of the sources of CAMEO's chemical data.

In both Table 6 and Table 7, the numbers in the table cells indicate the priority of the various databases used for each data field in a Chemical Library record. Smaller numbers indicate higher priority: “1” in a table cell indicates the highest-priority source for a particular piece of information. For example, Table 6 shows how the names for the chemicals in the Chemical Library were chosen. When different names for a particular chemical appeared in different databases, our preference was to adopt the name for that chemical used in the *Emergency Response Guidebook* (U.S. Department of Transportation 2000), our second preference was to use the name for that chemical listed in the *Title III List of Lists* (EPA 1999), our third preference was to use the name shown in 49 Code of Federal Regulations, and so on. In the case of synonyms for each chemical name, we included all the synonyms for a given chemical from the indicated sources.

Some of the information in the Chemical Library was edited by the CAMEO Team after it was extracted from the original source. In Table 6, chemical names shown in the Name field were taken from the sources shown and then further edited. Information in the Formula, CAS Registry Number, and Label fields was extracted from the sources shown, then lightly edited. In Table 7, texts shown in the General Description field were taken from the sources shown and then further edited; molecular weights were extracted from the sources shown, then lightly edited.

TABLE 6. Sources of chemical identification information in Chemical Library records. (See “Bibliography” on page 276.)

	49 CFR	DOT	AAR	USCG	CAS	NIOSH	LIST	NTP	EPA	TECH
Name	3	1	6	4			2	5		
UN/NA Number	1	2	4					3		
Formula					1			2		
CAS #				5	1	4	3	2		
STCC #			1							
DOT Label	1							2		
CHRIS Code				1						
Synonyms		1		1	1	1	1	1	1	
Regulatory Information^a							1			
Screening & Scenarios^b										1

- a. Items under the Regulatory Information tab, including regulated names, threshold quantities, and other information established by one or more Federal laws: the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), EPCRA (Sections 302 and 313), and the Clean Air Act (Section 112r).
- b. Items under the Screening & Scenarios tab, including liquid factors, level of concern, and physical state at ambient temperature. All these items are used for hazards analysis. See “Using Screening & Scenarios to assess hazards” on page 137.

Sources of CAMEO's chemical data

TABLE 7. Sources of RIDS data in Chemical Library records.

	NFPA	AAR	EPA	USCG	DOT	Little	NIOSH	ACGIH	NTP	CAS	AIHA	DOE	React ^a	LIST
General Description		1	2	3			5		4					
Fire Hazards			1	2	3				4					
Firefighting		2	1	3	4				5					
Protective Clothing summary text		4	2	3			1		5					
Protective Clothing ratings table						1			2					
Non-fire Response		1	2	3	4				5					
Health Hazards			1	2	3		4		5					
First Aid		6	1	4	5		3		2					
Reactivity													1	
Reactive Hazards													1	
Flash Point		5	1	3			4		2					
Lower Explosive Limit (LEL)			1	3			4		2					
Upper Explosive Limit (UEL)			1	3			4		2					
Autoignition Temperature		3		1					2					
Melting Point		5	1	3			4		2					
Vapor Pressure		5	1	3			4		2					
Vapor Density			1	3					2					
Specific Gravity		4	1	2			5		3					

TABLE 7. Sources of RIDS data in Chemical Library records.

	NFPA	AAR	EPA	USCG	DOT	Little	NIOSH	ACGIH	NTP	CAS	AIHA	DOE	React ^a	LIST
Boiling Point		5	1	3			4		2					
Molecular Weight			2	4			5		3					
IDLH							1							
TLV-TWA								1						
TLV-STEL								1						
ERPG											1			
TEEL												1		
Water Solubility							2		1					

- a. This source is the Chemical Reactivity Worksheet, which contains a database of reactivity data and other chemical information compiled by NOAA and EPA (online at response.restoration.noaa.gov/chemaids/react.html).